

CLAIMS:

1. A method of preparing object files on a first device that are used for rendering two-dimensional images of three-dimensional objects on a second device by processing object files containing data defining triangle primitives representing at least one three-dimensional object to determine a rendering order in which said triangle primitives may be rendered for creating a two-dimensional image in which the hidden surfaces are removed comprising the steps of:
- a) storing a plurality of planar triangle primitives corresponding to a plurality of surface portions of said at least one object in an object file, wherein said plurality of triangle primitives are represented by vertex data arranged according to an original order,
 - b) selecting a triangle that does not potentially occlude any of the unprocessed triangles to start a triangle strip,
 - c) selecting a neighboring triangle to add to the last triangle in the triangle strip,
 - d) determining whether the selected triangle can potentially occlude any of the unprocessed triangles,
 - e) adding the selected triangle to the strip and going back to step c) if the selected triangle cannot potentially occlude any of the unprocessed triangles,
 - f) going back to step b) to start a new triangle strip if the selected triangle can potentially occlude any of the unprocessed triangles, and
 - g) repeating steps b) to f) until all the triangles in the object file are processed.
2. A method according to claim 1, in which step b) comprises a heuristic search to identify those triangles for starting a strip that potentially allow long strips

to be formed, preferably by selecting triangles that do not have many unprocessed neighbors.

3. A method according to claim 1 or 2, further comprising
5 the step of dividing the object file into two, if at step b) it is impossible to find a triangle not occluding other, still unprocessed, triangles.

4. A method according to claim 3, in which the object is
10 divided by using binary space partitioning techniques, preferably using any partitioning plane, so that at least one of the unprocessed triangles remains on a different side than the unprocessed triangles it can potentially occlude, in which preferably a plane of an arbitrary
15 unprocessed triangle is used and the triangle is associated on the outward side of the splitting plane, thus leaving all the triangles that it may cover on the other side.

20 5. A method according to any of claims 1 to 4, further comprising the step of determining the front side and the triangle planes of the triangles in the object file wherein the determination if a selected triangle can occlude any of the unprocessed triangles comprises the
25 steps of determining whether:

g) the selected triangle has one or more vertices on the front side of the plane of any of the unprocessed triangles, and
h) whether any of the unprocessed triangles positively
30 identified in step g) have one or more vertices on the backside of the plane of the selected triangle.

6. A method according to any of claims 1 to 5, comprising further the following steps before step b)
35 i) determining if the object has symmetry in the XY-plane of the object space,

- j) storing a determined plane of symmetry in the object file, and
- k) removing all vertices in the object file from one side of a determined plane of symmetry, and
- 5 repeating steps i) to k) for the XZ-plane of the object space and for the YZ-plane of the object space.

7. A method according to any of claims 1 to 6, further comprising the step of:

- 10 l) transferring said object file or files from said first device to a second device after step f) or k) and storing the object files on said second device.

8. A method according to any of claims 1 to 7, in which
15 said first device comprises a higher performance image processing means, such as used in a PC or a workstation and said second device comprises a lower performance processing means such as used in a mobile communication terminal or a PDA.

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9. A method for displaying object files obtained by the method of any of claims 1 to 8, on said second device, comprising the steps of:

- m) determining the viewing direction, and
- 25 n) determining the object order, preferably using the painter's algorithm and displaying said object or objects on said second device.

10. A method according to claim 9, further comprising the
30 step of:

- o) culling all triangles facing backwards relative to said viewing direction.

11. A method according to claim 9 or 10, further
35 comprising the steps of:

p) retrieving planes of symmetry stored in the object file, and

q) creating a duplication of the vertex data present in the object file, said duplication of the vertex data
5 having the same order as the original vertex data and being stored in the object file after the original vertex data, and flipping the sign of the vertex values on the axis orthogonal to the respective retrieved plane of symmetry of the duplicated vertices.

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12. A method according to any of claims 9 to 11, further comprising the steps of

r) displaying the triangle strips in the same order as they were created, and

15 s) displaying the triangles in the triangle strips in the same order as they were added to the strip.

13. A method according to any of claims 9 to 12, in which said second device comprises a lower performance
20 processing means such as used in a mobile communication terminal or a PDA.

14. A method according to any of claims 9 to 12, in which said second device is a mobile phone.

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15. A method according to claim 13 or 14, in which the image rendering process is carried out by the main CPU of the device, and all the further image rendering means is software embedded.

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16. A mobile communication terminal comprising

- means to store object files containing triangle strips, and

- means to display said triangle strips in the order
35 in which they have been created, which preferably

corresponds to the order in which triangle strips are stored in the object files.

17. A mobile communication terminal according to claim 1,
5 wherein the triangles in the triangle strips are displayed in the same order as they were added to the strip, which preferably corresponds to the order in which they are stored in the triangle strips.
- 10 18. A mobile communication terminal according to claim 1 or 2, wherein a rendering order of said objects is determined using a binary space partitioning method.
- 15 19. A mobile communication terminal according to any of claims 16 to 18, comprising means for culling all triangles facing backwards relative to the viewing direction.
- 20 20. A mobile communication terminal according to any of claims 16 to 19, further comprising means for retrieving planes of symmetry stored in the object file, and means for duplicating all vertex data present in the object file and flipping the sign of the vertex values on the axis orthogonal to the respective plane of symmetry
25 for the newly created triangles.
- 30 21. A mobile communication terminal according to any of claims 16 to 21, in which the image rendering process is carried out by the main CPU of the device, and all further image rendering means is software embedded.
- 35 22. A method of preparing on a first device object files used for rendering two-dimensional images of three-dimensional objects on a second device by processing data defining triangle primitives representing at least one

three-dimensional object, comprising on said first device the steps of:

- a) storing a plurality of planar triangle primitives corresponding to a plurality of surface portions of said
- 5 at least one object, wherein said plurality of triangle primitives are represented by vertex data,
- b) determining the planes of symmetry of said three-dimensional object,
- c) storing planes of symmetry data in the object file,
- 10 d) culling all vertex data from one side of each said planes of symmetry,
- e) transferring said object file from said first device to said second device, and
- f) displaying said image on said second device by
- 15 mirroring said vertex data in said planes of symmetry and rendering said image.

23. A method according to claim 22, in which planes of symmetry that are not parallel with one of the X-, Y- or

20 Z-axis of the object coordinate system are ignored.

24. A method according to claim 22 or 23, in which said first device comprises higher performance image processing means, such as used in a PC or a workstation

25 and said second device comprises lower performance processing means such as used in a mobile communication terminal, a PDA or a handheld video game.

25. A method according to claim 24, in which said second

30 terminal is a mobile phone.

26. A mobile communication terminal comprising image processing means for rendering images of three-dimensional objects on a display, means for storing

35 vertex data, means for storing planes of symmetry data and means for mirroring vertex data in a symmetry plane.